

Functional adaptation of the right ventricle to different degrees of the left ventricular systolic dysfunction in patients with left-sided heart disease: a three-dimensional echocardiography study

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Background. Right ventricular (RV) systolic dysfunction in patients with left-sided heart disease is known adverse factor. However, the RV adaptation at the different degrees of left ventricular (LV) dysfunction remains to be clarified.

Purpose: to assess the change in RV contraction pattern in relation to LV ejection fraction (EF) in patients with left-sided heart disease.

Methods. LV and RV volumes and EF were measured by 3D-echocardiography in 295 patients with left-sided heart disease (59 ± 17 years, 69% male). The 3D meshmodel of the RV was postprocessed by the ReVISION software and its contraction pattern was decomposed along the longitudinal, radial and anteroposterior directions (Fig. A) providing longitudinal, radial and anteroposterior EF (LEF, REF, AEF). Relative contribution of each component to the RV systolic function was measured as the ratio between LEF, REF and AEF and global RVEF (LEFi, REF_i, AEF_i).

Results. Patients with LV systolic dysfunction also had reduced RVEF. Relative contribution of the longitudinal and anteroposterior components decreased, while radial component increased in patients with reduced LVEF (Table).

RV LEF and AEF significantly correlated with the LVEF (Rho 0.50 and 0.51, $p < 0.0001$), while the correlation between REF and LVEF was weak (Rho 0.22, $p = 0.0002$).

There was a significant drop in LEF and AEF (Fig. B) and their relative contribution to the total RVEF (Fig. C) starting from the earlier stages of LV dysfunction. However, it was effectively compensated by significant increase in the radial RV component resulting in preservation of total RVEF in those with normal, mildly and moderately reduced LVEF (50 [46;54] vs 47 [44;52] vs 46 [42;49]%), whereas total RVEF dropped significantly only in severe LV dysfunction (30 [25;39]%; $p < 0.0001$) (Fig. D).

Conclusions. The longitudinal and anteroposterior RV contraction was related to the LVEF and decreased from early stages of the LV systolic dysfunction. Increase in the radial component compensated for the loss of longitudinal and anteroposterior RV components in mild and moderate LV dysfunction to maintain total RVEF. Drop in all three components resulted in significant reduction of total RVEF in severe LV dysfunction.

Characteristics of study population

	Overall (N = 295)	LVEF \geq 50% (N = 166)	LVEF < 50% (N = 129)
LV EF, %	49.6 \pm 14.3	59.9 \pm 5.6	36.4 \pm 10.9*
RV EF, %	46.5 \pm 9.2	49.8 \pm 6.9	42.3 \pm 10.0*
RV LEFi	0.42 \pm 0.09	0.45 \pm 0.09	0.38 \pm 0.09*
RV REF _i	0.47 \pm 0.1	0.45 \pm 0.1	0.50 \pm 0.09*
RV AEF _i	0.39 \pm 0.08	0.41 \pm 0.08	0.37 \pm 0.07*

* $p < 0.0001$

Abstract Figure.

